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GOVERNMENTAL CONTROL OF WATERPOWER
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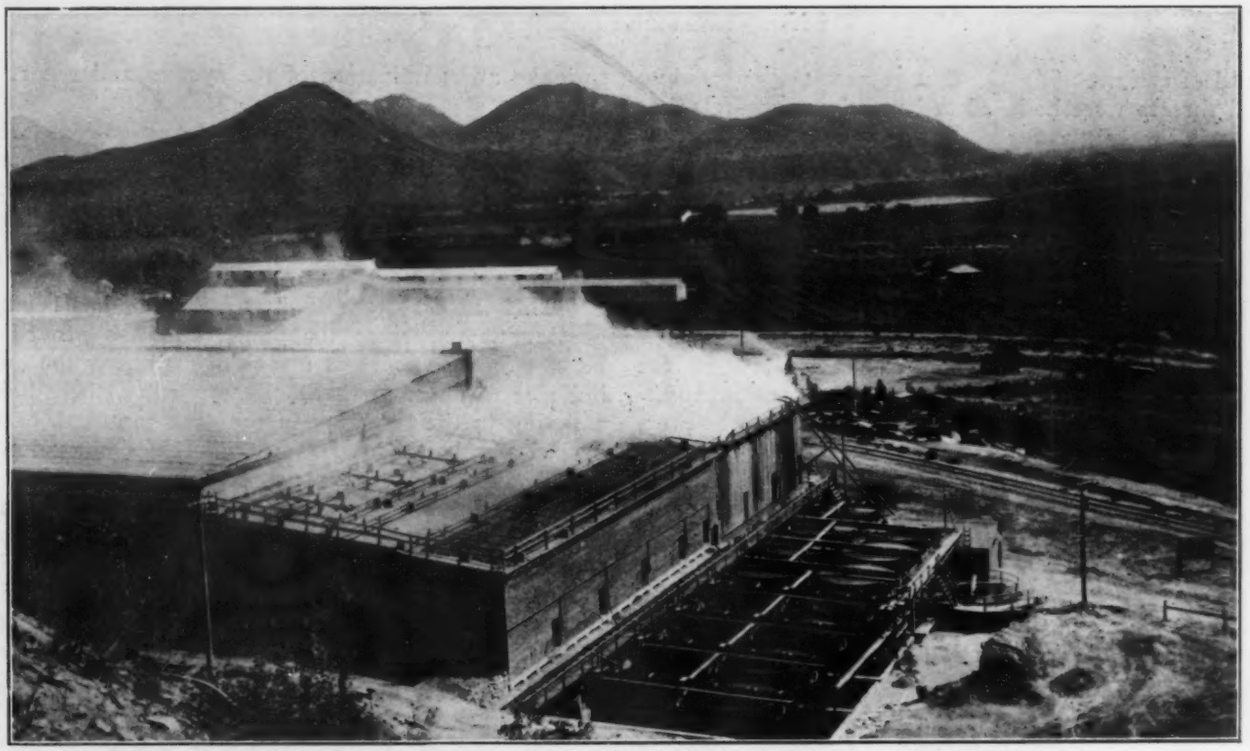
THE FLEMING DUST COLLECTING SYSTEM

BY W. C. HANNA.

(This paper gives the details of the process whereby the California Portland Cement Company is enabled to operate its Colton, California, plant without dust damage to surrounding orange groves. It was presented at the seventh semi-annual meeting of the American Institute of Chemical Engineers, Los Angeles, Cal., August 18, 1915. The author is chemist for the cement company.—The Editor.)

As visitors pass out of the large acreage of orange and lemon groves owned by the California Portland Cement Company and come within closer view of the splendidly equipped mill at the foot of Slover Mountain, those familiar with the general appearance of cement manufacturies notice a decided difference and the machinery connected with them constitute the Fleming patent dust collecting system which is receiving much attention from cement manufacturers throughout the United States, and back of which lies a history of interest to all connected with the cement industry.

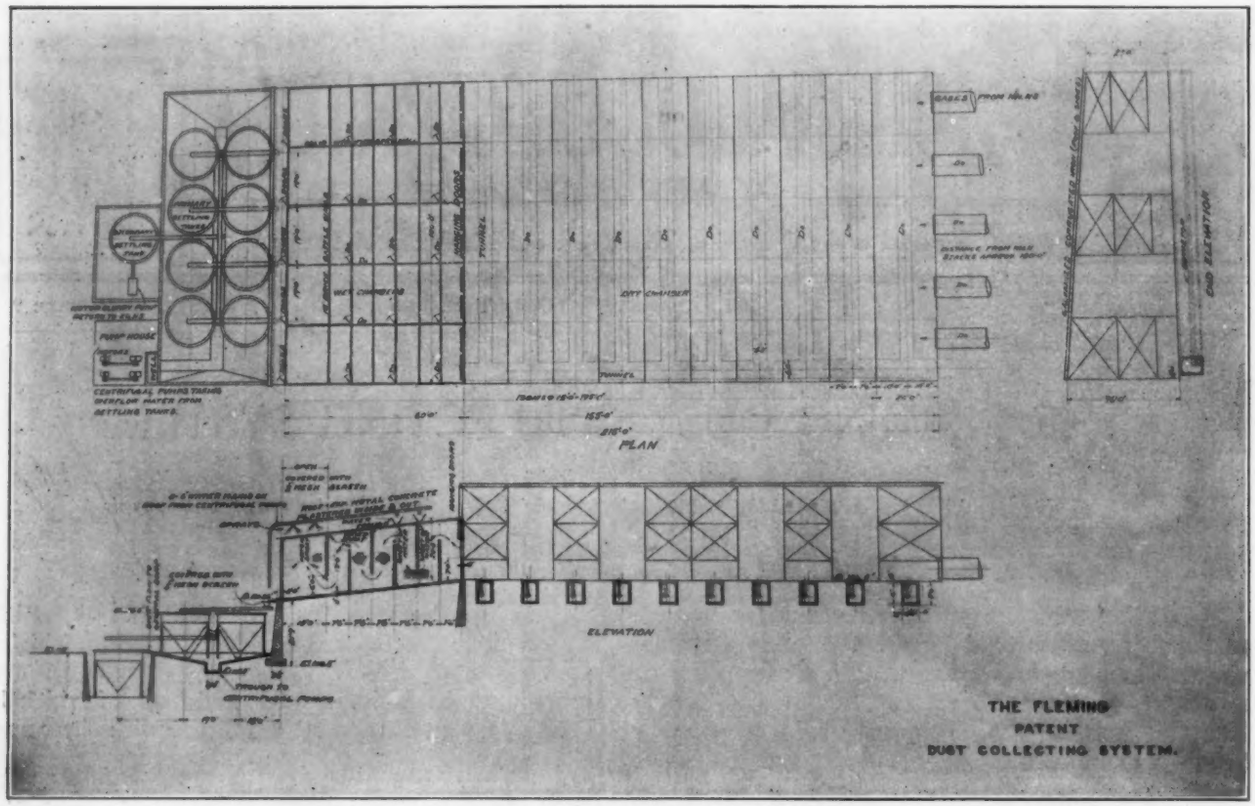


Dry Chamber, Wet Baffle Chamber and Settling Tanks of Colton Dust Settling Plant.

in this one. There is something lacking which is common to the industry—or has been in years gone by. There are no kiln and dryer stacks with their objectionable trail of dust and fumes.

How it is possible to have such a condition in a factory of this size is explained by the buildings at one side of the plant, from the end of which large volumes of water vapor are pouring. These buildings

Orange growers in the vicinity of Slover Mountain began to complain in 1909 about dust emanations from the kilns and dryers of the cement plants operated at Colton. At that time the new or largest plant was one of the most modern in the United States and was considered by cement manufacturers a clean plant, and as there had never been any recorded injury to people or vegetation in the neighbor-



Fleming Patent Dust Collecting System.

hood of cement mills, the orange growers' complaints and threats were believed to be without grounds, but serious enough, however, to warrant an extensive line of investigations and experiments with all known methods for capturing the dust.

These investigations were continued with zeal, but nothing of sufficient effectiveness was found. In the meantime the orange growers, not being satisfied with the efforts of the cement company, brought suit against it and, in the trial during July and August of 1910, expert testimony from many parts of the world covered much of the field of cement manufacture, dust collecting devices, and agriculture as practiced in the vicinity of Colton.

The Superior Court granted the orange growers an injunction in April, 1911, which became effective in June of that year, but, by that time, experiments at the old cement plant had proved so satisfactory that T. J. Fleming, secretary and general manager of the company, had most of the material on the ground for constructing his dust collecting system on a practical scale for five rotary kilns 7½ ft. in diameter and 120 ft. long. By September, 1911, the first kiln was operating to the dust house and, shortly afterwards, all of the kilns were operating at full capacity with the Fleming system. Meanwhile, throughout the mill, a campaign against dust was made, resulting in all grinding machines, elevators, and conveyors being made practically dustless.

The orange growers were not yet satisfied with the efforts of the cement company and brought suit for contempt of court. The evidence was such that the court was not satisfied, so he appointed Dr. R. E. Swain of Stanford University as an impartial expert to make an examination of the system and report to him.

Dr. Swain's very complete investigations were made in February, 1912, and the report which he made shortly afterwards was so favorable that the court dismissed the case, stating that the plant as operated was not a nuisance and was not being operated in contempt of court.

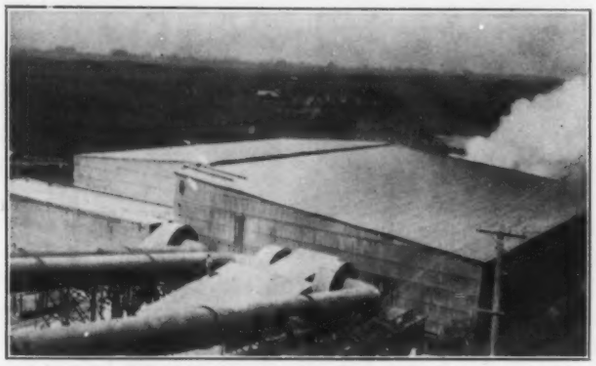
This same system of dust collecting has been in continuous use since that time, and has proved to be, not only an efficient means of capturing the dust, but also to be more than self-supporting, there being a saving to the company in the dust captured, better output per barrel of fuel oil, and less shut downs than before the Fleming system was in operation.

Very briefly, the installation consists of normal rotary kilns using dry process and oil for fuel. The draft for the kilns and dryers is produced by fans sucking at the end of separate flues. Instead of discharging the gases into the atmosphere, the same exhauster fan blows the dust and fume into a large chamber known as the dry dust settling chamber, where the velocity of the gases is reduced about 90 to 95 per cent, resulting in a large amount of dust being deposited. The extremely fine dust which does not settle, and the gases then go to the wet washing chambers where the gases are forced up and down several times while following a serpentine course through a system of seven baffle chambers, and the last of the original so-called cement dust is captured by sprays of water which are in each chamber.

These sprays of water also bring into solution much of the gases, lime, and alkalies. In connection with both the dry and the wet chambers there are

means provided for the removal of the captured dust to the cement kilns.

This paper will describe a unit in connection with three kilns 8½ ft. in diameter and 150 ft. in length with a capacity of 31 barrels of clinker per kiln hour, or about 2200 barrels per day, also one clay dryer



Fans and Flues, also Showing Dry Dust Chamber and Water Vapor Pouring from Wet Baffle Chamber.

which handles all of the clay used at the plant. This is the third large unit installed at Colton, each new unit, as installed, having a few improvements over the preceding one. The house has capacity for two more kilns of this same size.

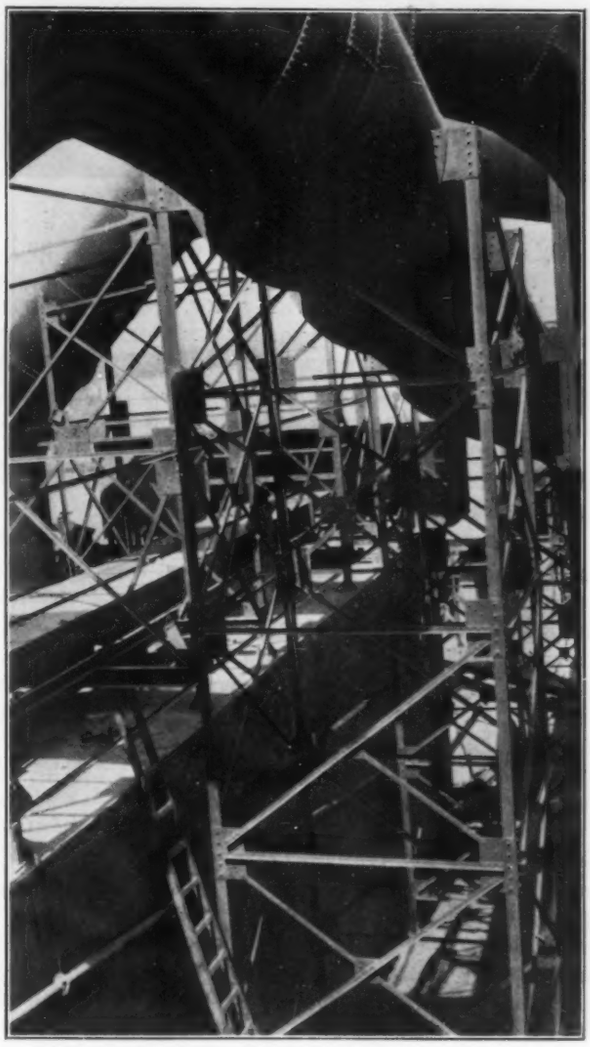
The fans which produce the draft in the kilns are located at the end of what would normally be the stacks to the kilns, but which in this case are about 180 ft. long and which, instead of being perpendicular, first rise from the stack base at the feed end of kiln then curve over and slope downward towards the fans. Each kiln is provided with a separate flue, fan and motor, so that the operation of any one kiln is independent. The flues are 6½ ft. in diameter, lined with fire brick for the first 20 ft., and they are provided with the necessary expansion joints.

The fans are of special exhauster type made by the B. F. Sturtevant Company. They are 5 ft. wide and 10 ft. in diameter, equipped with water cooled bearings and operate at a speed of about 145 r.p.m., each fan being driven by a 40 h.p. motor, although only 11.7 h.p. is required except when fan is first started. During the past year of continuous service there has not been a single hour lost due to fan trouble.

The results obtained by the kilns determine the speed at which fans are to be operated. Sometimes it is found to be desirable to give the kiln more draft, and the fan is operated at a faster speed, while at other times the reverse is true. The ease with which the draft in the kiln can be regulated is of great assistance in the economical operation of the rotary kilns.

A Thwing pyrometer is used in connection with the installation, the thermocouples being located in the flues near the fans, and the recorder in the kiln room where the cement burners can regulate the fires, keeping the temperature at the fans not higher than 900 degrees F. This, together with the perfect control over the draft and of the speed of the kilns, makes the condition ideal for the manufacture of Portland cement clinker. The draft, induced as above, has proved to be far easier to control than a stack draft, the life of the kiln lining is almost permanent, provided kiln is not allowed to get cold, the ring formation reduced, and the clinker produced more uniform in quality.

The discharge from the fans is just about the same as from an ordinary kiln stack, only the blast is horizontal instead of perpendicular and at an elevation



Kiln Flues Rising from Stack Bases and Sloping Downward Toward Fans.

that is convenient for treating the gases laden with dust in the dry dust settling chamber. The chamber into which the fans discharge the gases is 155 ft. long, 100 ft. wide, and 31 ft. high. It is a steel frame structure, with sides and roof covered with corrugated galvanized iron in order to promote radiation of heat. There are no barriers to a free passage of the flue gases within this chamber, except a set of baffle plates about 10 ft. wide extending across the chamber in a line about 30 ft. in front of the inlet flue openings. The temperature of the gases as they go to this chamber are 700 degrees to 900 degrees F. and on emerging from the same the temperature is 300 to 400 degrees F. Due to this reduction of temperature, and to the large area of the house there is 90 to 95 per cent reduction in the velocity of the flue gases, resulting in about two-thirds of the suspended dust particles or about 30 to 40 tons of dust per day being deposited in this dry chamber. There are ten cross

Three Kilns, With Flues Leading to Fans.

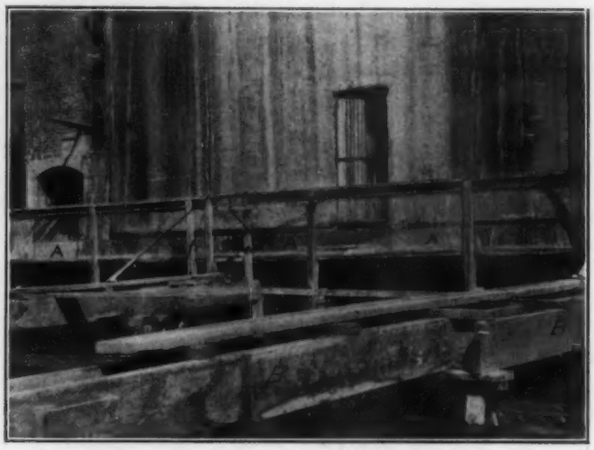
Kiln Flues to Fans and to Dust House.

tunnels beneath the floor of this department, and in each tunnel there is a screw conveyor with steel troughs and ten spouts, with gates, leading from the floor above into the conveyor for drawing off the dust. Each of these cross tunnel conveyors discharge into the conveyor running in the main tunnel and it, in turn, connects with a conveying system which carries the dust to a bin in the raw mill building. The dust is drawn from this bin and properly mixed with the material being fed to the kilns.

The gases, with the remaining dust, go to the wet baffle chambers which is the same width as dry chamber and 60 ft. long. The frame work is of steel, the sloping floors are of concrete, the walls of brick and concrete, and roof of expanded metal encased by concrete. It is divided into five separate compartments, each 60 ft. long and 20 ft. wide. Each compartment receives the gases from the dry chamber through two openings, 6½ ft. by 9 ft., which may be closed by means of hanging concrete doors operated vertically from the room. Only three of these compartments are required and the two not in use can be kept in reserve in case any of the others should require new sprays or other work done on them. Each of these compartments has six transverse baffle partitions alternately rising from the floor and descending from the roof, leaving 6 ft. transverse opening through which the gases are forced, over the first baffle and under the second, and so on until they pass under the sixth baffle, emerge into the exit chamber, and through the roof, which is made of one-half inch mesh wire screening. The actual area of exit openings for each compartment is about 135 sq. ft. and the velocity of the gases about 250 ft. per minute.

Each baffle section in each of the five compartments is provided with a set of water sprays. The return water from the settling basins is used in all of the sections except the last ones. Each spray with return water is adjusted to carry about twelve gallons of water and each fresh water spray delivers about six gallons per minute. In these wet baffle chambers the remaining one-third of the dust in suspension is removed and the temperature of the gases reduced to about 125 degrees F. at the exit.

The water with its load of dust, falls to the sloping floor and runs to the end of the house, where it falls into a screen covered trough extending the entire length of the wall of the wet baffle chamber. Lateral troughs lead from this to the center of each of the eight primary conical, steel, settling tanks, 16 ft. in diameter. The overflow from these, being almost free from suspended matter, falls through the open air, in order to cool it, to the reservoir below from which it is pumped as return water at about 100 degrees F. by centrifugal pumps, back to the sprays. The thin slurry from the bottom of the conical primary settling tanks is syphoned through gooseneck pipes to a common trough which leads to a secondary conical settling tank. The clean overflow from this also goes to the common collecting reservoir, but its thick slurry, containing about 20 lb. of solids per



Exit water, (A) Falling With Load of Dust from Sloping Floors Into Main Trough; (B) Lateral Troughs Over Settling Tanks, (C) Surface of Water in Settling Tank.

cubic foot, is pumped to the slurry tank above the kiln stack bases from which it is continually fed to the rotary kilns.

The amount of water required to operate the Fleming system is much less than at first would be expected. The fresh water need not exceed 75 to 100 gallons per minute, and it has been found desirable to add this in the form of coarse sprays in the exit chamber, above the screen to the same, and in the baffle chamber just before exit chamber. The greatest part of the washing is done by the circulating water which amounts to at least 1000 to 1200 gallons per minute. The heaviest sprays of return water are located in the second baffle chamber after leaving the dry chamber.

The amount of dust captured each day in the dry dust chamber is about 30 to 40 tons, while about 15 tons is captured in the wet baffle chambers. Where only rotary kilns are operated in connection with the dust collecting system, the proportions of calcium oxide, silica and alumina found in both the dry dust and slurry are found to be such that they can be returned to the kilns without special attention being given to them. Where dust from dryers, such as clay dryers, is also collected in the same system the dust will contain an excess of clay and it must be returned with proper care. At the Colton plant the dust is used so as to balance up any irregularities in the composition of the raw mix as it goes to the kiln feed bins.

The method of using the dust will probably be of interest, so I will briefly tell you how it is blended.

The rotary kilns and the dust collecting system are in operation 24 hours each day, while the clay dryer operates at night long enough to fill the empty clay bins. The slurry from the wet baffle chambers after being thickened in the tanks, is pumped about every hour above kiln stack bases to a tank holding almost one day's run, and the slurry kept in agitation by compressed air. The hundred spouts under the dry dust chamber are opened daily, only on the day shift, and the dust conveyed to a bin of almost one day's capacity in the raw grinding department.

The amount of dust deposited in the collector from the kilns is very uniform and from the amount of clay used one day it can be closely estimated how much clay will be deposited in the chamber that night to be mixed with the kiln dust for use the next day and night.

The raw mix, as proportioned at the scales, is made of such composition that the dust must be added to it in order to give a suitable composition. The dry dust can be added to the ground raw mix at any desired speed, and from one to fifteen raw mills can operate without causing inconvenience. When everything is normal, the miller operates the dust feeder at a specified speed for each different number of mills that he may be operating, but in case the raw mix, as tested in the laboratory, is found to require a little more or less clay, the laboratory orders the dust feeder to be speeded up or reduced sufficiently to give the desired mixture. As the dry raw mix runs into the kilns, a small stream of the well mixed slurry from the slurry tank runs by gravity into the kiln.

The dust captured in the dry dust chamber is very fine, practically all passing a No. 200 sieve and about 97 per cent passing a No. 300 sieve. Both this dust and the extremely fine dust captured in the form of slurry have much more sulphur, potassium, and sodium than the raw mix, but after a few returns to the kilns they do not show any further increased percentages of these elements.

The water used in the wet baffle chambers very rapidly becomes heavily laden, chiefly with sulphur compounds of potassium, sodium and calcium, and when more than half a pound per cubic foot is found, some of the water is taken out and replaced by fresh water in order not to cause trouble with the sprays. Plans are being made to recover the potash.

The dust which is discharged into the air from the exit to house amounts to about one ton per day. This dust bears no resemblance to the original cement dust, it being for the most part sulphur compounds of potassium, sodium, and calcium and about 88 per cent to 94 per cent soluble in water. This dust is produced by the draft drawing out the fine sprays of water from the wet washing system much the same as the wind carries inland the salt water spray from ocean breakers.

The Fleming system requires little labor. The regular oiler looks after the fans in addition to the regular machinery. The raw mill operator regulates the dry dust feeder and the kiln feeder looks after the slurry when it requires attention. The man who operates the water pumps for entire cement, lime, and crusher plants, also operates the slurry pump and return water pumps. One man is required for nine hours per day to draw the dry dust from the dry dust chamber and another man looks after the wet washing system each day in order to keep things in proper condition. This latter man is at times aided by pipe fitters to repair pipe lines and laborers to help clean the compartments.

The power consumption is reasonable, not exceeding 2000 kilowatt hours per day, of which 57 per cent is used on the return water pumps.

The cost of placing the Fleming system in an old plant would depend upon the general layout of the plant, the amount of room available, and type of construction. In a new plant the apparatus can be placed with ease and at minimum cost.

In concluding my remarks with the customary contrast of results "before and after using," it is impossible to deal exclusively with the unit used thus far in this paper, as that unit has always operated with the dust collector in connection. Therefore it will be necessary to take results obtained with five kilns, 7½ ft. in diameter and 120 ft. long, which were operated for about 2½ years with normal practice and then for the same length of time with the Fleming System.

With this dust collecting system in use there are obtained:

First—About 24 per cent more clinker per barrel of fuel oil consumed.

Second—About 5 per cent more clinker produced per hour of kiln operation.

Third—About 2 per cent more actual operating time of kilns.

Fourth—Over 7 per cent less raw materials required for manufacturing a barrel of cement.

Fifth—The quality of the output was improved.

Sixth—Dust from dryers and kilns collected and the nuisance abated.

The world's production of petroleum in 1914 amounted to 400,483,489 barrels, according to statistics compiled under the supervision of J. D. Northrup of the United States Geological Survey. Of this record breaking output the United States is credited with 66.36 per cent, representing in quantity a trifle less than double the output of all the other oil producing countries combined. Changes in rank during the year affected only Japan and Peru, the former superseding the latter by a narrow margin.

THE SALINE METHOD OF WATER FLOW MEASUREMENT.

By W. D. PEASLEE.

[Concluded.]

Conductivity Method.

At this point in the investigation it became evident that while the method as developed was extremely accurate and reasonably easy of manipulation, there was need of further simplification of the method of analysis. The attention of the writer and staff was then turned to the investigation of the relation, in electrolytic solutions, between the electric conductivity and the salt content of the solution.

Working on the fact well established by Kohlrausch that the conductivity of pure water containing any electrolytic substance in solution is due almost entirely to the dissolved substance, and only in negligible degree to the water itself, it was found that with dilute solution the conductivity is almost exactly proportional to the amount of substance dissolved in the water. In other words the conductivity is proportional to the number of ions present as long as they are not so numerous as to prevent each ion moving in its own free path without collision with any other ion. Thus with proper precautions the electric conductivity is a measure of the amount of salt in the solution.

After considerable work in the field and laboratory the instrument shown in Fig. 3 was designed.

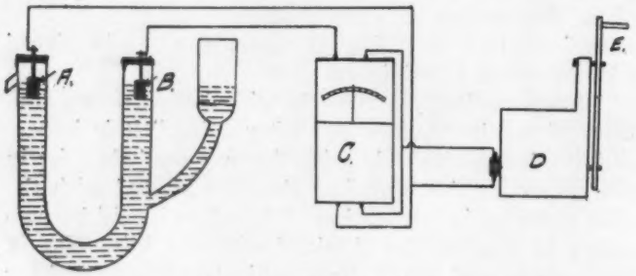


Fig. 3. Apparatus for Electrolytic Determination.

A U-tube is arranged as shown with an overflow so the height of liquid in it is always the same. **A** and **B** are bright platinum electrodes, **C** is a conductivity meter, and **D** is a continuous current hand driven dynamo, driven through gears by the Crank E. The U-tube is arranged so that when in place the distance through the electrolyte between the electrodes is always th same.

Making the tube long enough so that the resistance of the sample is much greater than the resistance of the lead-in wires and the current path near the electrodes, the formation of a small amount of gas on the electrodes has an entirely negligible effect on the resistance of the total circuit and further the electrodes are of such design as to reduce this effect to a minimum. They are made long and consist of radially spaced leaves, giving great surface. Also as a result of this design any bubbles formed rise in the tube and escape, so that they cannot pass down into the sample and increase its resistance. Since it takes some time for gas to form on such electrodes in dilute solutions and the current need be applied for only three or four seconds to obtain a reading it will be readily appreciated that the gas formed is entirely inappreciable in effect. It has been found that with ordinary laboratory methods of measurement the effect of the gas is not noticeable within the time required to secure a reading, using the electrodes described.

The counter electro-motive force of polarization has been found, in the case of bright platinum elec-

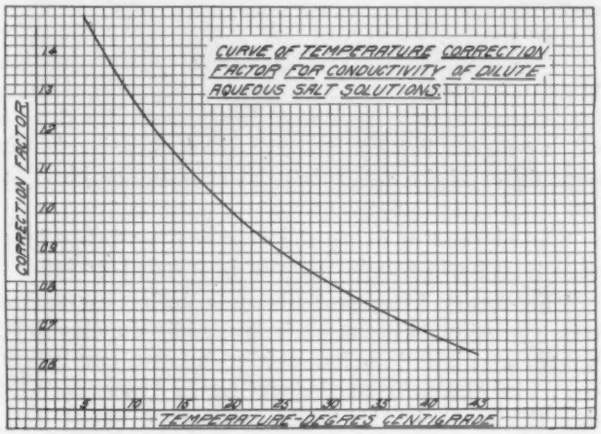

CURVE OF TEMPERATURE CORRECTION FACTOR FOR CONDUCTIVITY OF DILUTE AQUEOUS SALT SOLUTIONS.
CORRECTION FACTOR
TEMPERATURE-DEGREES CENTIGRADE

Fig. 4. Curve of Temperature Correction Factors for Conductivity Apparatus.

trodes and dilute salt solution to be closely to two volts. This would of course increase the apparent resistance of the sample and so decrease the apparent conductivity and is therefor taken into account in calibrating the instrument.

The dynamo may be of the slipping clutch type which will give a constant voltage when the crank is turned above a certain speed or the conductivity meter may be arranged, as is the case with some meggers on the market to indicate conductivity regardless of the voltage applied.

In using the water care must be taken to wash the tube thoroughly after each test with distilled water and to dry it to preserve the integrity of the next sample.

The effect of temperature on the conductivity of such solutions is well known and the curve of correction factors for temperature of the samples is shown in Fig 4. In using the equipment a thermometer is placed in the filling tube to indicate the temperature of the sample. The reading of the conductivity meter is then multiplied by the correction factor corresponding to the temperature of the sample which gives the conductivity at 20 degrees Centigrade and all readings are reduced to conductivity at this temperature.

This entire equipment can be put up in a reasonably sized case, making a compact and portable set.

The instrument is calibrated as follows: several standard salt solutions are made up from .01 to about 1.0 gram equivalents per litre salt content and brought to 20 degrees Centigrade. At this point the relation between conductivity and salt content is known. The conductivity of these samples is then measured and the results plotted as shown, Fig. 5. This gives a calibration curve between readings of this particular instrument and the salt content of any sample tested within its range. This curve takes into account the cross section variations of the U-tube, the polarization

and gas effects, and any individual characteristics of the meter and dynamo.

Fig. 5 is the actual calibration curve used in some of the experimental work, employing a potentiometer to measure the resistance of the sample and computing the conductivity from the resistance readings.

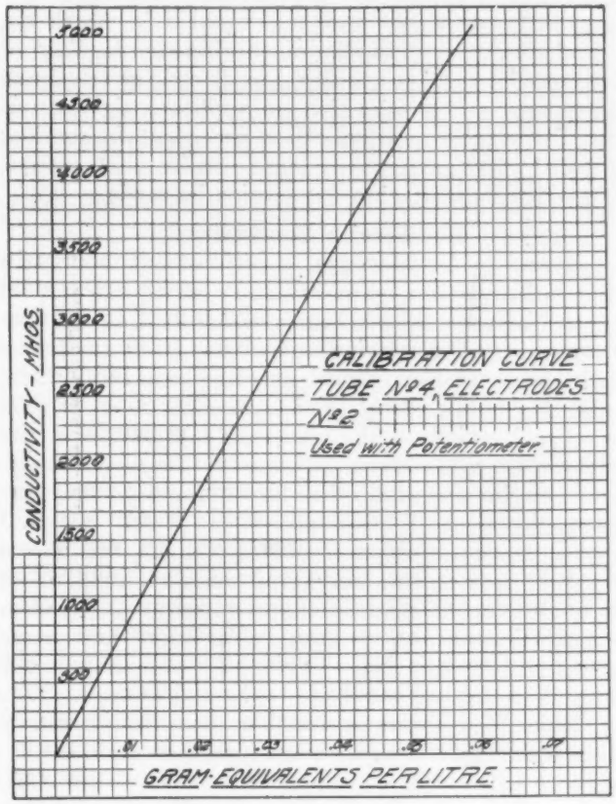


Fig. 5. Calibration Curves of Conduvtivity Apparatus.

Referring again to the test results previously discussed, the samples were also tested by the conductivity method, using the curve of Fig 5 with the following results.

Conductivity of dilution of dosing sample, 2140, 20 deg. C.

Conductivity of evaporated solution sample after dosing, 410, 20 deg. C.

Conductivity of evaporated solution sample before dosing, 480, 20 deg. C.

From the curve in Fig. 5 we find that,

2140 = .0238 gram equivalents per litre.
410 = .00438 gram equivalents per litre.
480 = .0056 gram equivalents per litre.

Then $V_0 = .0238 \times 10{,}000 = 238.$
$V_2 = .00438 \times 20 = .0876.$
$V_3 = .0056.$

Then from equation (5) $Q + q =$

$$\left(\frac{238 - .0056}{.0876 - .0056}\right) .94625 = 2745.3 \text{ litres per sec.}$$

Thus it is seen the three methods used yield results agreeing within less than 4 parts in 2745 which is far greater accuracy than necessary in commercial work. The results obtainable with the salt solution method are far more accurate than are obtainable with any other method known by the author; and the simplicity of manipulation, and the cheapness with which it can usually be applied, are factors that should appeal to all engineers who are interested in the measurement of water flow.

In the following table a few of the tests made during the investigation are collected to show the range over which the method has been applied and the accuracy obtainable:

		Discharge in Litres per second.		
Conditions.	Means of Check.	Check.	Titration.	Conductivity.
Triplex pump discharge	Venturi meter	1.565	1.571	
Flow in flume.....	Weir	286	285.6	286.13
Cent. pump discharge..	Weir	6.84	6.836	6.829
Flow through turbine	G.E. Flow meter*	1242	1253.33	1250.2
Cent. pump discharge...	Weir	2745	2741.34	2745.3

*Accurate to plus or minus 1 per cent under the conditions.

CALIFORNIA RAILROAD COMMISSION ORDER ON SERVICE CHARGES, CONNECTIONS AND EXTENSIONS.

Following are the rules and regulations established by the Railroad Commission of California for the guidance of all water, gas, electric and telephone utilities of the state as regards charges, deposits, contracts and guarantees for services, service connection and service extension:

I. Service Charges.

A. Metered Service.

Rule 1. A water, gas, electric or telephone utility may, under uniform, non-discriminatory rules and regulations, require that an applicant for metered or measured service establish his credit before service is delivered, unless a prepayment device makes such procedure unnecessary. The applicant's credit will be deemed established if he (1) owns the premises; or (2) makes a cash deposit; or (3) furnishes a guarantor for the payment of his bills, satisfactory to the utility; or (4) has paid all his bills to the utility promptly during the twelve months prior to the effective date of the order herein.

Rule 2. If an applicant for metered or measured service makes a cash deposit to insure payment for service to be delivered, the amount of the deposit shall be such as may be specified in the utility's rules, but in no event in excess of twice the average periodic bill of consumers of his class; provided that the deposit for domestic or residence monthly service of water, gas, electric and telephone utilities shall not exceed $2.50.

Rule 3. If a consumer who has initially established his credit by showing that he is the owner of the premises, or by supplying a guarantor satisfactory to the utility, or by paying all his bills to the utility promptly during the twelve months prior to the effective date of the order herein, later fails to pay his bills, the utility may demand as guaranty for the payment of future bills a cash deposit in the amount provided by Rule 2; provided that service may not be discontinued for failure to make such deposit until the time specified in Rule 5 herein after notice of intention to discontinue service unless such demand is complied with.

Rule 4. If a consumer who has made a cash deposit fails to pay a bill for metered service, the utility may apply the deposit in so far as necessary to liqui-

date the bill and may require that the deposit be restored to its original amount; provided that service may not be discontinued until the deposit has been fully absorbed, and in no event until the expiration of the respective periods of time after notice of intention so to do, as specified in Rule 5 herein.

Rule 5. A water, gas, electric or telephone utility may not, for failure to make a deposit, discontinue a metered service for which bills are normally made out monthly until the expiration of at least fifteen calendar days after written notice of intention so to do; nor where the bills are normally made out weekly until the expiration of at least four calendar days after written notice of intention so to do; nor where the bills are normally made out fortnightly until the expiration of at least seven calendar days after written notice of intention so to do; nor where the bills are normally made out for periods in excess of one month, until the expiration of at least thirty calendar days after written notice of intention so to do.

Rule 6. A water, gas, electric or telephone utility may not discontinue service by reason of non-payment of bills for metered or measured service theretofore delivered.

Rule 7. A telephone utility may, under uniform, non-discriminatory rules and regulations, extend the convenience of sending telegrams and long distance telephone messages on credit to all its patrons or to the extent of such deposits as any of its patrons desire to make.

B. Unmetered Service.

Rule 8. A water, gas, electric or telephone utility delivering unmetered service at flat rates may, under uniform, non-discriminatory rules and regulations, require payment in advance of delivery, for a period not to exceed that for which bills are regularly rendered as specified in the rate schedule, but may not demand guaranties to secure payment for service to be rendered in the future.

Rule 9. A water, gas, electric or telephone utility may not for failure to pay for service, discontinue an unmetered service for which bills are normally made out monthly until the expiration of at least fifteen calendar days after written notice of intention so to do; nor where the bills are normally made out weekly until the expiration of at least four calendar days after written notice of intention so to do; nor where the bills are normally made out fortnightly until the expiration of at least seven calendar days after written notice of intention so to do; nor where the bills are normally made out for periods in excess of one month, until the expiration of at least thirty calendar days after written notice of intention so to do.

C. Return of Deposits.

Rule 10. After a cash deposit to guarantee payment for metered or measured service has stood unimpaired for twelve months, it shall be returned to the depositor. Upon closing any account the balance of any deposit remaining after the closing bill for service has been settled shall be returned promptly to the depositor.

Rule 11. Interest at the rate of 6 per cent per annum must be paid by each water, gas, electric or telephone utility on all deposits held by it to secure the payment of bills for metered service; provided, that interest need not be paid if the service is discontinued within less than twelve months from the date of first taking service.

D. Contracts.

Rule 12. Except in the case of extensions in unincorporated territory, which matter is left open for consideration in subsequent proceedings, and of extensions in incorporated territory in cases in which the commission may hereafter authorize the signing of contracts for service, a water, gas, electric or telephone utility may not require that an applicant sign a contract for service as a condition precedent to service; provided, that such utility may require that reasonable written application for service be made.

II. Service Connections.

Rule 13. A water, gas, electric or telephone utility which operates upon, under or along any public street, highway, alley, lane or road shall at its own expense install a service connection of normal size to the property line or curb line of property abutting upon said public street, highway, alley, lane or road or to such point on the consumer's premises as the utility may agree upon. The term "service connection," as herein used, shall include water and gas pipes, electric and telephone wires, water, gas and electric meters, electric transformers, gas regulators, telephone instruments and appurtenances. Subject to review by the Railroad Commission, a water, gas, electric or telephone utility may refuse to make a service connection if it believes that the service will not be used in the reasonably immediate future.

Rule 14. Under reasonable, non-discriminatory rules and regulations, to be prepared in the first instance by the utility, subject to review by the Railroad Commission, a water, gas, electric or telephone utility may provide that the cost of disconnecting and reconnecting service connections may be (1) charged directly to the new or the resuming consumer; or (2) distributed over the periodic payments over a reasonable period of time; or (3) merged in the general operating expenses. The so-called "cancellation charges" of water, gas, electric and telephone utilities are hereby abolished.

III. Extensions.

Rule 15. A water, gas, electric or telephone utility which operates under a general franchise authorizing the occupancy of all the streets of a municipality shall make, at its own expense, such street extensions as may be necessary to serve applicants; provided that in any case in which the construction of an extension at the utility's sole cost will in its opinion work an undue hardship upon the utility or its existing consumers, the matter may be submitted to the commission as provided by section 36 of the Public Utilities Act, unless satisfactorily adjusted by an informal application to the commission.

Rule 16. A water, gas, electric or telephone utility shall make such reasonable extensions in unincorporated territory at its own expense, as it can agree upon with the applicant for service; provided that in any case in which the construction of an extension at the utility's sole expense will in its opinion work an undue hardship upon the utility or its existing consumers, the matter may be submitted to the commission as provided by section 36 of the Public Util-

ities Act, unless satisfactorily adjusted by an informal application to the commission.

Rule 17. In any case in which an applicant makes a payment to secure the construction of an extension by a water, gas, electric or telephone utility, such payment shall be considered as a loan to the utility, to be repaid under reasonable, non-discriminatory rules and regulations. Interest shall be paid on such loans at the rate of 6 per cent per annum.

IV. Modification of Rules.

Rule 18. A water, gas, electric or telephone utility may establish uniform, non-discriminatory rules more favorable to its consumers than the rules herein established.

3. The rules and regulations herein established shall take precedence over orders heretofore made by the commission in other proceedings, in so far as said orders may be inconsistent with said rules and regulations.

3. The rules and regulations herein established shall take precedence over all rules and regulations filed or to be filed by water, gas, electric and telephone utilities in so far as inconsistent therewith. Rules and regulations now on file and inconsistent with the rules and regulations herein established should be revised and refiled within sixty days from the effective date of this order.

4. Within thirty days after the effective date of this order, each water, gas, electric and telephone utility shall return to the depositor all deposits heretofore made to guarantee payment for flat rate service and all deposits made to guarantee payment for metered or measured service by patrons who have paid all their bills promptly during the twelve months prior to the effective date of the order herein.

5. If hardship results from the application to special facts of any rule or regulation herein prescribed, application may be made to the Railroad Commission for a modification.

6. This order shall become effective on October 11, 1915.

LETTER TO THE EDITOR.

Federal Water Power Legislation.

Sir: I find myself nearly always agreeing with your editorial articles, which are sane and practical, and I have come to look forward each week with great interest to receiving and reading your publication.

After reading your editorial in the issue of July 24th, entitled, "An Unjust Tax," and upon reading over the changes which I suggested in my article on "Federation Water Power Legislation" be made in Section 8 of the Ferris Bill, I can see that my views might be misconstrued, and in any event, that I might have made them clearer. I intended to change the bill so that the government could only collect a charge or rental for government land used, based solely upon the land value and not based in any way upon the power developed or sold. The government does not own the water, and is only entitled to the same return for the use of its land that any other land owner would be entitled to. Very truly yours,

Seattle, Wash., Aug. 16, 1915. HENRY S. PIERCE.

GOVERNMENTAL CONTROL OF WATER-POWER.

BY GEO. C. CHAMBERLAIN.

(In order that our readers may be familiar with the arguments employed by the proponents of the Ferris Bill, the concluding portion of an address on this subject before a joint meeting of the bar associations of Oregon and Washington, August 14, 1915, at Portland, is here published. The author is U. S. Senator from Oregon. Discussion on the several points of the argument is invited for publication.—The Editor.)

It will generally be found that the same elements which in times past have opposed the withdrawal of public lands for forestry and other purposes, are arrayed against any efficient restrictive or regulative legislation as affecting waterpower sites or the development of hydroelectric energy. True, they are compelled, in view of present conditions, to admit that legislation is necessary if there is to be development. Present legislation is wholly unsatisfactory, both to the government and to the investor; but, looking at the question from the selfish viewpoint; they would have both congress and the state legislatures follow a course which would be so liberal to the waterpower companies that there would practically be no authority left to regulate or control them.

Let us look at the situation as it really is, and then judge whether or not legislation is necessary and, if so, whether it should be enacted without due regard to the public interest.

The Geological Survey of the United States estimates that the total available potential horsepower in the United States is 61,678,000, of which about six million has been developed; and that of the total potential horsepower 44,049,000, or about two-thirds thereof, is in the Western States. The development of this power will materially aid in the development of the West, and it goes without saying that every Western state is interested in seeing that such legislation is enacted as will not hamper, but will promote, the development of this power; and yet I for one had rather see these splendid resources undeveloped and our powers unharnessed than to see such legislation enacted as will deprive the governments, state and national, of future ability to regulate and control.

How is this development distributed, as far as it has gone, and is there or has there been a tendency toward concentration and monopolization? It is contended by those representing the power companies—and that, too, very earnestly—that there is not such a concentration of waterpower development as to give rise to the danger of a power trust. And yet it has been pretty well established, notwithstanding repeated denials of the fact that in the states of California, Colorado, Idaho, Montana, Nevada, Oregon, Utah and Washington, out of a total development of 1,135,400 h.p., 1,023,700 h.p., or 90 per cent of the development, is owned by twenty-three companies, while only 10 per cent is owned by small developers. Two groups of companies in California own 57 per cent, or 300,000 h.p., of the total development in that state, while three companies own 90 per cent of the total development in Oregon. Taking the evidence before the Senate and House committees, and reports which have from time

to time been made by public officials, on the waterpower possibilities of the country, the conclusion is irresistible that there has been a tendency toward concentration of companies interested in power development. This, in itself, might, or might not be a menace, provided, of course, these companies are engaged only in intrastate development, and in states where utilities commissions have the power of rate regulation and control. But consolidation of development means the inevitable concentration of ownership or control, either directly or indirectly, of public utilities, water, heat, light, power and transportation. And therein lies the necessity for control of the power site, for the present and for the future, by the Federal Government; for its control means the ability to regulate the waterpower, as well as the public utilities, owned or operated by the power companies engaged in interstate business. The perpetual ownership by the Government of the power site means the authority to perpetually regulate the rates to be charged to the consumer, whether for water, heat, light, transportation, irrigation or energy utilized for any purpose whatsoever.

In the testimony before the Public Lands Committees of congress, the statement is made that ten groups of power interests control 65 per cent of the undeveloped commercial waterpower in this country. That one great power interest alone owns the street railways in 16, gas plants in 19, and electric light plants in 78 cities and towns; while companies clearly under the domination and control of the great power interests own street railways in 111, electric light plants in 660 and gas plants in 113 cities and towns throughout the country. That six waterpower interests own street railways in 29, electric plants in 204 and gas plants in 55 cities, among which are some of the most important cities in the country. A few instances are given where waterpower companies own public utilities in certain states, as follows: California, 8 street railways, 151 electric light plants and 37 gas plants; Connecticut, 16 street railways and 32 electric light plants; Maine, 16 street railways and 36 electric light plants; Michigan, 50 electric light plants and 5 street railways; New York, 71 electric light plants and 20 gas plants; Oregon, 29 electric light plants; Washington, 24 electric light plants, and Vermont, 25 electric light plants.

It is difficult, in fact, impossible, to estimate how many millions of people are involved now, and may become involved in future, by failure to properly exercise a power which we are now able to exercise by virtue of the government's ownership of the power sites on the undisposed portions of the public domain. It is all the more important therefore that whatever legislation congress sees fit to enact should only be after the most mature consideration.

Does not the testimony go to prove that there is a tendency to concentrate the ownership and to monopolize the development of the waterpower of the West? Already those interested in or advocating this concentration are beginning to denounce any and all attempts at federal legislation. They are making the same fight that was made when it was tried to prevent the acquirement by the few of the timber, coal, oil and gas resources of the country, using the same arguments, and are animated by the same selfish purposes. It is insisted by them that regulatory legislation by congress, through the instrumentality of the power sites situated within the public domain, is an interference with the right of the states to the fullest control of the waters within their borders. We find men and newspapers clamoring for states rights who have never heretofore mentioned the doctrine, except in derision. No one is proposing any legislation in congress on this all-important subject which does not fully and completely recognize the rights of the states within their proper jurisdiction.

I know how potent with the unthinking is the argument that every man who insists upon safe and conservative legislation in the interest of the masses stands against the development of the state. I have seen and heard it made against those who have stood in the breach to oppose legislation that in the end would have turned over to corporate greed the undisposed of portions of the public domain. It is an argument which is being made now in some quarters, to open up for exploitation the forest and other reserves in the several Western states, and that without regard to whether the lands upon which these forests are growing are suitable for agricultural purposes or not. It is an argument which is made ostensibly in the name of those who are seeking to acquire homes for themselves in the undeveloped West, when in truth and in fact everyone who has been an observer of the trend of legislation in the past quarter of a century knows that these plausible arguments are not in the interest of the homeseeker and the homebuilder, but are in the interest of, and are in some instances, paid for by, those who are anxious to obtain, and have obtained, these lands for monopolistic control. No legislation should be enacted by congress which will surrender its jurisdiction to control and regulate for all time the rates to be charged for power used in interstate business, and I do not think there will be.

Those who have stood for conservation have not desired, and do not now desire, that the natural resources of the country should be permanently locked up and withheld from economical and proper use. Conservation does not mean permanent reservation, but it does mean the economical and rational use by those of the present, with some regard for the rights of future generations.

So it is in the matter of waterpower. The advocates of the withdrawal of lands for waterpower sites have not favored the non-utilization of this power. They have always, and do now, favor the greatest possible use and development of the waterpower of the public-land states, but economical and rational use under the reasonable supervisory and regulatory power of the national and state governments. They oppose any disposition of them that will deprive the people of the power to regulate, and open the way for monopolization, not only of the power generated, but of the various utilities for which that power is capable of being used and upon which they are dependent. In other words, they believe in the conservation of this power for the use of all the people, and to that end in legislation that will encourage their fullest development and use.

Why should not this encouragement be given to waterpower development, if it is a fact, proven beyond question, that it can be furnished to the consumer cheaper than power can be generated by steam and that for every horsepower per annum developed by water there is a saving of 15 tons of coal? In other words, why should not every patriotic citizen favor the use and development of a constant and perpetual force and its substitution for a force which can be developed and used only at the expense of another, which when destroyed can never be restored? This is true conservation.

So now the plea is made for laxity in legislation, not in the interest of the safe, sane and conservative development of the West, but in the interest largely of those who hope to profit at the expense of the people of the West through the concentration and monopolization of the waterpower sites and the waters thereon and in the several states.

Why are the selfish interests so afraid of federal control and regulation? Those who are so anxious for state control, and who have no fear of state legislatures and state commissions ought to be able to give some substantial reason for the fear of one and the pretended desire for the other form of regulation.

The fact is, the people of the West who have no selfish interest to subserve want both federal and state control and regulation, the one operating upon interstate development and transmission of electric energy and the other upon what is largely a matter of intrastate concern. The jurisdiction of the federal authorities finds an anchorage in the power site located upon the public domain, and that of the state is based upon the ownership of its non-navigable waters within its boundaries.

But while insisting upon legislation which will protect the people against concentration and monopolization of waterpower sites and developed energy, and consequent unreasonable rates that might be charged, it must not be forgotten that capital will not seek investment in these enterprises unless it feels that it can do so with safety and with the assurance of a reasonable return on its outlay.

Legislation, therefore, while safeguarding the public interest, ought to be reasonable. There ought not to be, and I am sure there is no war between those who believe in conservation and those who are seeking investment in waterpower undertakings.

In the very nature of things it will be difficult to secure the enactment of a law by congress that will fully protect the public interest and at the same time entirely satisfy the selfish interest, but in spite of opposition there will be legislation at the ensuing session, or at least in the very near future, for under the law as it is today the development of waterpower is an impossibility. Capital will not seek investment in an enterprise where there is no fixity of tenure and where the license or lease may be at any time arbitrarily revoked by governmental agencies. Further than that, there is no assurance to the consumers that electric energy will be furnished to them for any fixed or definite period. A law to invite capital to invest in power development must establish a fixity of tenure, and outline the conditions of the lease in advance, so that the investor may know what to expect on the termination of his lease. On the other hand, to protect the public it must guard absolutely and for all time against monopoly, unreasonable rates to the consumer, and provide for the restoration of the power site to the public domain at the end of the lease or any renewal thereof upon the payment of a just sum to the lessee.

The bill pending in congress, if carefully analyzed, meets all these requirements. It may be that it will require some slight amendments, but in its general scope and purpose it is as nearly ideal as it is possible to frame such a bill in the present state of the public mind. It recognizes the federal and the state jurisdiction, and the respective rights of each; and while it may not be perfect, it is hoped that in the main it may be enacted at the ensuing session of congress, so that true development might begin in the public-land states. Those who are engaged in fighting and in denouncing the measure, if they really are the friends of Western development, ought rather to turn their attention to assisting, by proper analysis and criticism, to whip the measure into such shape as will protect the public and at the same time encourage the development of the country.

Regulation, rather than revenue, ought to be the basis of all legislation governing the development of waterpower. It does not matter much, either to the federal or to the state government, whether the revenue derived from the development of horsepower is much or little; to undertake to exact an exorbitant charge will postpone or prevent the very purposes of legislation. It is better that no revenue be derived than that no development be had, but the essential thing for the state and national government is that the power of regulation in the interest of the public be maintained, with the power at the end of a stated period to renew its contract with the lessee, upon such terms as legislation and conditions at that time may warrant, or at its option to take back the developed plant upon terms which shall then be just to both the lessor and the lessee.

It must not be forgotten that whatever charge is imposed upon the power company, whether it be great or small, must be paid by the consumer, upon the same principle that every dollar added to the charge for transportation of freight is paid by the producer in a diminished price for the product or the consumer in an added charge therefor.

I have detained you already too long, and I conclude by appealing to each of you, as loyal and patriotic citizens, to lend your efforts to the enactment of a law which, while it will assist in the development of the West, for the enjoyment and enrichment of the present generation, will at the same time protect them against extortion and place it in the power of future generations to control and regulate a business which may be of greater importance to them than to those of the present.

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Federal Control of Waterpower

Senator Chamberlain's remarks to the bar associations of Oregon and Washington this week are noteworthy as coming from a Western man. He is supposedly well informed on matters of such deep interest to the people of Oregon as the development of their waterpower resources. Consequently his endorsement of the Ferris Bill carries sufficient weight to warrant an analysis of his remarks as printed elsewhere in this issue.

The gist of his argument is that the federal government should retain perpetual ownership of power sites in order that it may perpetually regulate the rates for all public utilities. He adduces testimony to prove that there is a tendency to concentrate the ownership and to monopolize the development of the water power of the West. He accuses selfish corporate interests of attempting to defeat any legislation intended to properly regulate and control waterpower users. He advocates the Ferris Bill as a panacea for all the ills of the past. Let us study it for a moment.

In the first place, this bill is endorsed by the men who have already succeeded in halting the development of water power during the past five years. They framed the present laws, which even Senator Chamberlain admits makes the development of waterpower an impossibiiity. Notwithstanding the most positive assertion of men who know that capital cannot be induced to invest in waterpower projects under the terms proposed, these conversational conservationists fatuously ignore any suggested changes which would encourage development.

The advocates of the Ferris Bill contend that waterpower developers should serve two masters, that they should be regulated by the Secretary of the Interior in matters wherein they are already regulated by the public service commission. As a remedy for alleged centralization of water power they propose a further centralization of political power in a federal bureau. In one place they state that their purpose is not revenue but regulation. In another they propose an excise tax of virtually five per cent on an industry which is already paying its proper proportion of the taxes.

This tax is manifestly unjust for it is levied upon a thing of little intrinsic value. The courts recognize that the value resides not in the few acres constituting a power site but in the water which might be retained on that site after dams and power plants have been built. Furthermore this tax must eventually be borne by the power user, who will thus be compelled to pay higher rates.

Contrary to Senator Chamberlain's assertion the power companies are not afraid of federal control and regulation. They fully realize the benefits accruing but desire assurance that the regulation will be equitable and upon terms which will encourage development.

The Ferris Bill is not the instrument to bridge the gap between those who are willing and anxious to use the waterpowers and those who would see them continue to run idly to the sea. The time has come for the conservationists to make certain concessions in order that the West be in a position to enjoy its natural resources.

The Federal Trade Commission

The mistakes of some business men are largely responsible for demoralization in trade. A new man with limited capital and even more limited experience, entering the electrical business, for example, in three months can do more harm, not only to himself but to every one else in the same line, than is caused by a war or crop failure. This is typical of the conditions which the Federal Trade Commission is trying to remedy. When its purpose is understood its efforts should have the united backing of every business man in the country.

One of the most telling points brought out in the series of hearings held by the commission on the Pacific Coast during the past few weeks has been the innate selfishness of each branch of industry. The lumber men appear to care nothing about the welfare of the shipping or railroad companies as long as they can be put in a position to sell lumber at a profit. The same disregard of the right of others seem to characterize every other set of men called before the commission.

Would it not be better for all to work together for the general upbuilding of business conditions? Then each in turn would benefit and order would replace much of the present chaos.

It has been made clearly evident that the motives of the commission are of the best. They regard their duty as a constructive function. They are trying to build up rather than tear down, being somewhat unique in this respect. Their announced plan calls for methods of teaching and helping business men, particularly those conducting a small business.

With this aim in view they suggest that approved uniform methods of accounting be adopted by each line of trade. This would show each man definitely whether he is making or losing money and indicate just where the gain or loss is being made. Suggestions will also be given as to what constitutes fair methods of competition and in every way the small merchant will be given proper guidance.

These matters could well be handled through the instrumentality of associations of manufacturers, jobbers, dealers or other division of each trade. It might be well to make membership in such an association compulsory, on the line of reasoning that the judgment of broadminded men of affairs is better than repeating the mistakes of tyros. Membership could be open to anyone with sufficient experience, ability and capital to comply with the conditions prescribed by the commission. Such an association could be more effectively regulated than could a large number of individual companies.

It is as yet too early to prophesy what will be the result of the commission's close-range study of the various problems which it is called upon to meet. Without doubt, however, a definite program of foreign trade expansion will be evolved and the business men of the country will become better acquainted with the laws under which their businesses must be conducted. The cordial co-operation which has been accorded the commission in the West should hearten them in their earnest efforts to improve existing conditions.

Engineering Experiment Stations

The United States lacks ways and means for organized industrial research. While private endowment has provided a few centers for scientific investigation, there is still great need for engineering experiment stations in every state in order to give intelligent study to local engineering problems. Just as agricultural experiment stations have been instrumental in fostering better methods of farming so would engineering experiment stations improve many public works.

Such stations would in no way compete with practicing engineers, but on the other hand would greatly assist them. There are many problems of research from which no immediate financial return can be expected, yet the future public welfare requires their solution.

State-supported experiment stations have already been established in many of the colleges. Their bulletins are regarded as among the most authoritative literature on the several subjects treated and their work on the natural resources of each state has extended the college's sphere of influence far beyond the limits of the campus and has been of material benefit to several industries, especially those interested in tests on the strength of materials. At the University of California a series of investigations has shown how the waste of water in irrigation may be avoided.

In the West, the one subject of road making requires much costly experimentation in order to arrive at the best material and form of construction. There is need for a better understanding of how electricity can be applied to lessen labor on the farm. Many communities require instruction in methods of purifying their water supply. Many other matters will suggest themselves as proper functions for study by such stations.

As a means whereby these stations might be established throughout the country the suggestion of the deans of engineering colleges, who have just finished their annual conference at Berkeley, California, should have the hearty support of every engineer. They propose that the federal government allot an appropriation of $15,000 for each land-grant university for the purpose of engineering research. If this amount were supplemented by an equal appropriation from each state it would provide sufficient funds to start work on the better utilization of the natural resources of each state. Germany owes much of her commercial supremacy to the research work of her scientists, as is well exemplified in the dye industry. In order for a nation to be a leader, its endeavors should be based on such investigation.

PERSONALS

L. T. Merwin, superintendent Northwestern Electric Company, Portland, Ore., is visiting at San Francisco.

Murray Orrick of the Western Electric Company, San Francisco, is on a trip through Humboldt county.

W. W. Dick of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., was at San Francisco this week.

D. D. Smalley, electrical engineer for the Merced Stone Company, Merced, Cal., was at San Francisco during the week.

H. B. Woodill of the Woodill, Hulse Company, Los Angeles, Cal., Spent several days during the week at San Francisco.

Chas. T. Johnson, president of the Dover Manufacturing Company, Canal Dover, Ohio, is making a business trip on the Pacific Coast.

Julius M. Bamberger, president of the Utah Railway Company. Salt Lake City, Utah, was a visitor at San Francisco during the week.

F. H. Poss, manager of Benjamin Electric Company, at San Francisco, has returned from a trip to Santa Cruz and the Monterey Bay region, California.

W. S. Berry, sales manager of the Western Electric Company, San Francisco, has returned from an extended stay in the Santa Cruz mountains.

H. E. Sanderson, Pacific Coast manager of the Bryant Electric Company, is making an extended business trip to Portland and the Northwest.

W. C. Wurfel, manager of the Westinghouse Lamp Company, San Francisco, returned the first of the week from the Northwest.

R. W. Murphy, formerly of the Westinghouse Lamp Company, Los Angeles, Cal., has been transferred to the San Francisco office of the company.

J. B. Bridges, vice-president of the Gray's Harbor Railway & Light Company of Aberdeen, Wash., has succeeded **P. A. Bertram,** resigned, as general manager.

L. J. Corbett, professor of electrical engineering at the University of Idaho, has returned to Moscow, Idaho, from a visit to California.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, has returned to San Francisco from a trip to Japan.

C. E. Patterson, comptroller of the General Electric Company, is spending a few days at the Los Angeles office, in the course of a trip throughout the entire country.

Dr. E. F. Roeber of New York, editor of "Metallurgical and Chemical Engineering," is attending the convention of the American Institute of Chemical Engineers at Los Angeles and San Francisco.

H. H. Arnold, engineer for Anderson and Meyers, Peking, who has been making an extended business trip through the manufacturing centers of the East left San Francisco this week for the Orient.

H. V. Carter, president of the Pacific States Electric Company, San Francisco, left the first of the week to attend the National Electrical Supply Jobbers' Convention at Niagara Falls, New York.

Henry F. Holland, Pacific Coast manager of the Simplex Electric Heating Company, has returned to Los Angeles after an extended and successful trip covering the entire territory west of the Rocky Mountains.

H. Clark, foreman electrical department of the Pacific Electric Railway at Los Angeles, and **J. Pendel,** assistant to the superintendent of the mechanical department, were visitors at San Francisco during the week.

E. D. Stewart, representative of the Westinghouse Electric & Manufacturing Company at El Paso, Texas, is returning from a visit to the Panama-Pacific International Exposition by way of Los Angeles and Arizona.

Geo. B. Muldauer, field manager for the Society of Electrical Development, has been confined at one of the San Francisco hospitals for the past two months with a severe attack of inflammatory rheumatism. He has hopes of resuming his duties by the first of September.

H. H. Daley of the sales force of the Westinghouse Lamp Company, San Francisco, has resigned to enter into the automobile supply agency business. **L. F. Youdell,** an electrical dealer of Stockton, Cal., will also engage in new line of work with Mr. Daley in addition to maintaining his electrical store.

W. E. Peters, sales representative of the Western Electric Company in Oregon, has just completed a successful demonstration tour throughout the towns of the state where electric cooking rates are three cents or better and reports large sales of Hughes electric ranges. Electric cooking schools in co-operation with the electric company, were conducted by **Miss M. G. Dry,** demonstrator-lecturer for the company, in each town visited, a vigorous advertising campaign supplementing the work.

WATER POWER CONFERENCE.

The following delegates have been appointed to the Water Power Conference at Portland, September 21, 22, 23:

Idaho—John W. Hart, Menan; John F. McLane, Boise; Arthur M. Bowen, Twin Falls; F. S. Randall, Lewiston; James H. Hawley, Boise.

North Dakota—James F. Randall, Minnewaukon; H. W. Braatelin, Williston; John O. Hanchett, Harvey; James Johnson, Minot.

Washington—A. H. Imus, Kalama; W. V. Wells, Anacortes; M. C. Harris, Hoquiam; Phil H. Adams, Ellensburg.

Montana—Henry L. Meyers, Hamilton; T. J. Walsh, Helena; J. B. Collins, Miles City; Sam D. Goza, Helena; J. E. Erickson, Kalispell.

Colorado—Philip B. Stewart, Colorado Springs; Frank H. Means, Saguache; George E. West, Durango; A. P. Ardourel, Boulder.

Utah—A. R. Barnes, Salt Lake City, Attorney-General; W. D. Beers, Salt Lake City, State Engineer; W. M. Ferry, Salt Lake City; L. R. Anderson, Manti; L. B. Wright, Salt Lake City.

California—A. E. Chandler, San Francisco; Irving Martin, Stockton; W. A. Johnstone, San Dimas.

Arizona—Howard S. Reed, Phoenix; A. F. Sanguinetti, Yuma; T. A. Riordan, Flagstaff; W. H. Lawrence, Tucson, Alex T. Nelson, Sacaton; William F. Dermont, Williams.

Oregon—C. S. Hudson, Bend; S. B. Huston, Portland; Edgar B. Piper, Portland; W. Lair Thompson, Lakeview; Governor Withycombe, ex-officio chairman.

LOS ANGELES REJUVENATION.

Under special dispensation from Reigning Jupiter Homer E. Niesz, J. Harry Pieper, tribune of the Jovian Order at Los Angeles, held a private rejuvenation at the Los Angeles Athletic Club on August 12th. At this time some of the most prominent men in the electrical industry in Southern California joined the order, as is indicated in the following list of initiates:

S. M. Kennedy, General Agent, So. Cal. Edison Co.
A. W. Childs, Supt. of Sales, So. Cal. Edison Co.
E. H. Mulligan, District Agent, So. Cal. Edison Co.
A. B. Wollaber, District Agent, So. Cal. Edison Co.
W. R. Neelands, District Agent, So. Cal. Edison Co.
Fred Schwartz, District Agent, So. Cal. Edison Co.
C. S. Walton, District Agent, So. Cal. Edison Co.
A. A. Taylor, District Agent, So. Cal. Edison Co.
E. D. Stead, Bookkeeper, So. Cal. Edison Co.
C. H. Peirson, Advertising Agent, So. Cal. Edison Co.

W. L. Percey, Treasurer, So. Cal. Edison Co.
H. M. Fay, Power Salesman, Pomona Dist., So. Cal. Ed. Co.
Paul J. Denninger, District Agent, So. Cal. Edison Co.
Harry J. Bauer, Asst. Attorney, So. Cal. Edison Co.
H. C. Stinchfield, Chief Surgeon, So. Cal. Edison Co.
P. H. Booth, 2d Vice-President, Hotpoint Elec. Heating Co.
E. P. Morphy, Secretary, Home Telephone Co.
L. D. Walker, Asst. Purchasing Agent, Home Telephone Co.
H. M. Cleveland, Wiring Dept., J. E. Wilson Co.
C. N. Driskell, Manager Wiring Dept., J. E. Wilson Co.
E. Woodbury, Elec. Engineer, Pacific Light & Power Corp.
E. R. Davis, General Manager, Pacific Light & Power Corp.
A. M. Kemp, Treasurer, Pacific Light & Power Corp.
G. C. Ward, Vice-President, Pacific Light & Power Corp.
W. M. Baurhyte, Vice-President, L. A. Gas & Electric Corp.
C. P. Houghton, 2d Vice-President, L. A. Gas & Elec. Corp.
C. S. Vance, 3d Vice-President, L. A. Gas & Electric Corp.
E. L. Ellingwood, Consulting Mechanical Engineer.
E. L. Lewis, Superintendent, Los Angeles Railway.
W. N. Best, Jr., Sales Manager, Kieruiff Co.

PLANS FOR RECEPTION OF AMERICAN ELECTRIC RAILWAY ASSOCIATION AT SAN FRANCISCO.

In accordance with announcement made by Mr. Thos. Finigan, vice-president of the American Electric Railway Manufacturers' Association, under date of August 14th, a meeting of the various local representatives of the member companies of this organization, together with C. N. Black, vice-president and general manager, United Railroads, San Francisco, and W. R. Alberger, vice-president and general manager, San Francisco-Oakland Terminal Railways, representing the American Electric Railway Association, was held at the Palace Hotel August 16th.

After a general discussion of the most advisable plans for providing entertainment and comfort for the attending delegates, the following committees were appointed:

Entertainment Committee.
A. V. Thompson, chairman; General Electric Co.
C. F. Bulotti, Eccles & Smith Co.
R. D. Holabird, Ohio Brass Co.
H. B. Green, Pennsylvania Steel Co.
J. B. Struble, Union Switch & Signal Co.
Richard B. Carr, Loraine Steel Co.
W. E. Amann, Galena Signal & Oil Co.
J. H. Steiger, American Brake Shoe & Foundry Co.
H. R. Noack, Pierson, Roeding & Co.
H. S. Clark, Westinghouse Traction Brake Co.
F. H. Jones, General Railway Signal Co.
J. H. Handlon, United Railroads of San Francisco.
J. H. Brown, San Francisco-Oakland Terminal Railways.

Hotel and Registration Committee.
C. E. Heise, chairman; Westinghouse Elec. & Mfg. Co.
R. F. Behan, Westinghouse Elec. & Mfg. Co.
E. C. Myers, General Electric Co.
H. A. Beuter, Baldwin Locomotive Works.
F. A. Richards, J. G. Brill Co.
S. P. Russell, H. W. Johns-Manville Co.
F. F. Bodler, The Tool Steel Gear & Pinion Co.
Ed. Sullivan, Pantasote Co.

Local Transportation Committee.
A. G. Jones, chairman; General Electric Co.
G. R. Murphy, Electric Storage Battery Co.
F. H. Barker, Standard Motor Truck Co.
F. W. Webster, Allis-Chalmers Mfg. Co.
S. M. Gilman, John A. Roebling's Sons Co.
W. P. Bell, Standard Underground Cable Co.
H. T. Jones, United Railroads of San Francisco.
Geo. H. Harris, San Francisco-Oakland Terminal Railways.

Information Bureau.
W. P. L'Hommedieu, chairman; Westinghouse El. & Mfg. Co.
Stuart Hazlewood, Midvale Steel Co.
C. H. Pennoyer, National Conduit & Cable Co.
L. W. Wolcott, Sherwin-Williams Co.
Gus Koch, St. Louis Car Co.
F. H. Leggett, Western Electric Co.
W. P. Millner, Dearborn Chemical Co.
S. H. Lanyon, Federal Signal Co.

Press and Publicity Bureau.
N. A. Bowers, chairman; Electric Railway Journal.
A. H. Halloran, Journal of Electricity, Power and Gas.
Noble Hamilton, United Railroads of San Francisco.
J. H. Brown, San Francisco-Oakland Terminal Railways.

Mr. Finigan advised that the Manufacturers' Association would provide $1500 from the general fund for entertaining purposes.

Judging from the experience of other conventions and the nature of entertainment to be provided, it was thought that this amount would not be adequate to cover all expense, and, therefore, it was deemed advisable to appoint a finance committee to solicit and handle the additional money necessary for the purpose, but as it was impossible to determine the approximate amount to be required, it was decided that the chairman of each committee prepare a budget and program of their proposed plans and spbmit same to the general committee for ratification at the next meeting.

After a motion duly made and seconded, Mr. Charles N. Black, Mr. W. R. Alberger and Mr. Thos. Finigan were elected as a finance mommittee.

After considerable further discussion of various subjects, upon motion duly made and seconded, the meeting adjourned until Friday, August 27th, at which meeting it is expected that each committee will be prepared to submit definite plans of the proposed work of their committee.

PROPOSED ENTERTAINMENT OF ELECTRIC RAILWAY MEN IN SOUTHERN CALIFORNIA.

As delegates to the San Francisco convention of the American Electric Railway Association and American Electric Railway Manufacturers' Association, October 4-8, will spend two days at Los Angeles and vicinity and two days at San Diego and vicinity, a Southern California committee of entertainment has been formed to arrange for their reception. J. McMillan, vice-president and general manager of the Pacific Electric Railway Company, has been elected chairman and K. E. Van Kuran, district manager of the Westinghouse Electric & Manufacturing Company, secretary of the committee. Mr. McMillan has appointed the following committee chairmen:

Finance committee, Mr. Paul Shoup, Pacific Electric Railway Company; San Diego entertainment, Mr. B. M. Warner, San Diego Electric Railway Company; reception committee, Mr. Seymour Swarts, Great Western Smelting & Refining Company; publicity committee, Mr. D. W. Pontius, Pacific Electric Railway Company; program committee, Mr. R. H. Husbands, Pierson-Roeding Company; club courtesies, Mr. C. A. Henderson, Los Angeles Railway Company; transportation committee, Mr. A. W. Arlin, General Electric Company; barbecue and music, Mr. L. O. Lieber, Los Angeles Railway Company; evening entertainment, Mr. S. I. Wailes, manufacturers' agent; Catalina trip, Mr. F. F. Small, Pacific Electric Railway Company; San Francisco registration, Mr. H. H. Hale, Galena Oil Company.

PROGRAM FOR INTERNATIONAL ENGINEERING CONGRESS.

The program of papers for the International Engineering Congress at San Francisco, September 20-25, 1915, has been announced by the committee of management. All sessions will be held in the Civic Auditorium. The opening session will be 10 A. M., Monday, September 20th, when the address of welcome will be given by the Mayor of San Francisco and addresses will be given by Honorary President General Goethals, honorary vice-presidents and distinguished delegates. The John Fritz Medal will be presented to Dr. James Douglas.

The Panama Canal will be the subject of Monday afternoon's meeting, with six papers on its commercial and trade aspect, working force, purchase of supplies, geology, climatology and hydrology.

Thereafter parallel sessions will be held throughout the week on the general subjects of waterways and irrigation (eight sessions), municipal engineering (five sessions), railway engineering (five sessions), materials of engineering construction (five sessions), mechanical engineering (six sessions), electrical engineering (three sessions), mining engineering (three sessions), metallurgy (five sessions), naval architecture and marine engineering (seven sessions) and miscellaneous, including aviation, refrigeration, agricultural engineering, engineering education, scientific management, heating and ventilation (four sessions). Sessions will be held both morning and afternoon, except on Wednesday afternoon, when opportunity will be afforded to allow members to visit the engineering exhibits at the Exposition.

Among the papers of probable interest to readers of the journal are the following:

Waterways.

"The Province of Waterways in the Internal Commerce and Development of a Country," Brigadier-General W. H. Bixby, U. S. A., retired, Washington, D. C.

"Artificial Waterways Which Form Cut-Offs on Marine Routes, and Waterways Consisting of Natural Channels and Bodies of Water Linked by Artificial Channels, Constituting Inside Routes," C. S. Riche, member American Society Civil Engineers, Lieutenant-Colonel Corps of Engineers, U. S. A., Washington, D. C.

"The Waterway From the German Rhine Through the Netherlands to the North Sea, Along the Rivers, Rhine, Waal and Nieuwe Maas," C. A. Jolles, C. I., chief engineer-director of the government "Waterstaat," Arnhem, Netherlands.

"Natural Waterways in the United States," W. W. Harts, Lieutenant-Colonel, Corps of Engineers, U. S. A., Washington, D. C.

"Flood Control," H. M. Chittenden, Brigadier-General U. S. Army, retired, member American Society Civil Engineers, Seattle, Wash.

"Flood Control in China," Charles Davis Jameson, member American Society Civil Engineers, general advisor Chinese River Conservancy, Washington, D. C.

"Works for the Improvement of Navigable Estuaries," Professor Dr. Luigi Luiggi, inspector-general of civil engineers; professor of hydraulic construction at the Royal Polytechnic of Rome, Rome, Italy.

"The River Improvement Works in Japan," Tadao Okino, vice-president Civil Engineers' Society; chief engineer Home Department, Japan.

"Dry Excavation," Brigadier-General G. W. Goethals, late chairman and chief engineer Isthmian Canal Commission; Governor of Panama Canal Zone.

"Dredging in the Panama Canal," W. G. Comber, Paraiso, Canal Zone, Panama.

"Construction of Gatun Locks, Dam and Spillway," Brigadier-General W. L. Sibert, U. S. A., San Francisco, Cal.

"Method of Construction of the Locks, Dams and Regulating Works in the Pacific Division of the Panama Canal," S. B. Williamson, formerly division engineer, Pacific Division, Panama Canal.

"Lock Gates, Chain Fenders and Lock Entrance Caissons," Henry Goldmark, member American Society Civil Engineers, formerly designing engineer Isthmian Canal Commission, consulting enginer, New York, N. Y.

"The General Design of the Locks, Dams and Regulating Works of the Panama Canal," Brigadier-General H. F. Hodges, U. S. A., formerly assistant chief engineer Isthmian Canal Commission.

"Design of the Lock Walls and Valves of the Panama Canal," L. D. Cornish, member American Society Civil Engineers, formerly designing engineer for Isthmian Canal Commission, office of division engineer, War Department, Cincinnati, Ohio.

"The Design of the Spillways of the Panama Canal," E. C. Sherman, member American Society Civil Engineers, formerly designing engineer Panama Canal, consulting engineer, Boston, Mass.

"Emergency Dams Above Locks of the Panama Canal," T. B. Monniche, member American Society Civil Engineers, engineer of docks Panama Railroad, Cristobal, Canal Zone, Panama.

"Hydraulics of the Locking Operations of the Panama Canal," R. H. Whitehead, member American Society Mechanical Engineers.

Irrigation.

"Irrigation Enterprise in the United States," C. E. Grunsky, Dr. Ing., member American Society Civil Engineers, San Francisco, Cal.

"Economic Advisability of Irrigation," F. H. Newell, member American Society Mechanical Engineers, U. S. Reclamation Service.

"Distribution Systems, Methods and Appliances in Irrigation," J. S. Dennis, assistant to the president, C. P. R. R.; H. B. Muckleston, member American Society Civil Engineers, and R. S. Stockton, member Canadian Society Civil Engineers, Calgary, Alberta, Canada.

"Italian Irrigation, Professor Luigi Luiggi, D. Sc., member American Society Civil Engineers, professor of hydraulic engineering at the Royal University of Rome, and president of the Italian Society of Civil Engineers, Rome, Italy.

"Irrigation in Lybia" (Italian Colony), Professor Luigi Luiggi, D. Sc., member American Society Civil Engneers, professor of hydraulic engineering at the Royal University of Rome, and president of the Italian Society of Civil Engineers, Rome, Italy.

"Utilization of Underground Waters," G. E. P. Smith, associate member American Society Civil Engineers, irrigation engineer, University of Arizona, Tucson, Ariz.

"Irrigation in India," M. Nethersole, C. S. I., inspector-general of irrigation in India, Simla, India.

"Dams," Arthur P. Davis, member American Society Civil Engineers, chief engineer U. S. Reclamation Service, Washington, D. C.; D. C. Henny, member American Society Civil Engineers, consulting engineer, Portland, Ore.

"Earthen Dams," William Lumisden Strange, member Institute Civil Engineers, late chief engineer in Sind, India, Laracor, Mill Road, Worthing, England.

"The Distribution of Water in Irrigation in Australia," Elwood Mead, member American Society Civil Engineers, member Institute Civil Engineers, late chairman State Rivers and Water Supply Commission of Victoria, Australia, Berkeley, Cal.

"The Co-relation Between Demand and Supply, in View of the Variation Between Annual Demand and Supply From Natural Flow, Which Leads Up to a Study of the Amount of Storage Necessary," L. C. Hill, member American Society Civil Engineers, Los Angeles, Cal.

"Irrigation in Spain; Distribution Systems, Methods and Appliances," J. C. Stevens, member American Society Civil Engineers, Portland, Ore.

"Irrigation in Spain; Regulations Controlling the Use of Water, Metering Water for Irrigation and Methods of Charging," J. C. Stevens, member Society Civil Engineers, Portland, Ore.

"The Problem of Irrigation in the Argentine Republic," Carlos Wauters, member American Society Civil Engineers, member Institute Civil Engineers, president National Society of Engineers of Argentina, Buenos Aires, Argentina.

"Duty of Water in Irrigation," Samuel Fortier, chief of irrigation investigations, office of experiment stations, U. S. Department of Agriculture, Washington, D. C.

"Drainage as a Correlative of Irrigation," C. G. Elliott, member American Society Civil Engineers, Washington, D. C.

[To be continued.]

NEW CATALOGUES.

The Cutler-Hammer Electrically Heated Linotype Pot is the subject of a well illustrated 16-page booklet issued by the Mergenthaler Linotype Company of New York. The construction, application and operation of this electric pot are covered and the advantages over gas heated pots are pointed out.

A circular on the Cutler-Hammer push button 660 watt socket (pendent type) is being distributed to the electrical trade. This circular points out that the new section added to Rule 31 of the National Electrical Code requires sockets with 3-8 in. cap when not attached to a fixture, and must be provided with an approved insulating bushing.

NEWS NOTES

INCORPORATIONS.

TONOPAH, NEV.—The Sunshine Power Company has been incorporated, with a capital stock of $100,000. The nature of the business is to purchase and maintain electric light plants and gas plants. The incorporators are all of New Mexico. Principal place of business is Carson City.

ILLUMINATION.

RUPERT, IDAHO.—Town officials are considering taking over and improving the local electric lighting plant.

NEHALEM, ORE.—The new lighting system will be installed by the West Coast Electric Supply Company of Tillamook.

ROUNDUP, MONT.—The council tabled the resolution for the installation of an ornamental lighting system on account of protests. The estimated cost is $10,000.

PASADENA, CAL.—The commission has awarded a contract to F. O. Engstrum Co. for $751, for underground conduit for Mentoria Court from Terrace Drive east.

BLACKFOOT, IDAHO.—Blackfoot is considering plans for installing a system of street lights. The city council has been looking over the cluster lighting project in Pocatello.

ROSEBURG, ORE.—Petitions are being circulated here asking the city council to issue bonds in the sum of $250,000 for the construction of municipal and light systems.

LEWISTON, IDAHO.—Citizens and the Commercial Club, Robert S. Erb, president, are agitating the construction of a municipal dam on Snake or Clearwater River for furnishing power and lights.

SAN DIEGO, CAL.—Plans for an ornamental lighting system on lower Broadway from California street, to the municipal pier have been submitted to the council by City Engineer Cromwell. The cost would be $4839.

GLENDIVE, MONT.—A franchise has been granted by the board of county commissioners to the Montana Oil & Gas Company of Miles City, to lay gas mains alongside the county highways from wells on Cedar Creek into the city of Glendive.

HOOD RIVER, ORE.—The American Gas & Incineration Company has representatives here looking over the situation with a view of installing a gas plant for the purpose of supplying gas for lighting and cooking purposes. The proposition will be submitted to the council.

PHOENIX, ARIZ.—An election will be held in Electrical District No. 1 of Maricopa county, September 1st, to vote on the question of issuing bonds in the sum of $100,000 to be used in original construction of electrical power transmission lines and purchase of machinery, appliances, etc.

ASHLAND, ORE.—The city council has signed an agreement with the California Oregon Power Company, whereby the corporation vacates the field here, provided the municipality purchases its poles, lines and connections; the power company to sell current wholesale to the city. Election to be called August 25th to ratify the project and vote bonds.

PASADENA, CAL.—Bids received for the construction of an ornamental lighting system on Sonth Marengo avenue between Colorado street and Glenarm street were as follows: F. E. Newberry Electric Company, $8488; Chas. Glass, $8669; Southern California Electric Company, $8691; F. O. Engstrum Company, $8889; W. A. McNally Electric Company, $8950; Woodhill-Hulse Company, $9048; and M. A. Stampher Company, $9530.48.

BAKER, ORE.—The city commissioners have voted to raise the efficiency of the municipal power plant and to furnish lights for Main and First streets in the business section and to supply the electricity from the city plant. The present lighting plant's efficiency will be increased by eliminating waste at the penstock, where 1200 ft. of pipe will be enlarged. The cost will be more than $6000, and to secure the funds the commissioners will borrow $7500 from the South Baker pipeline fund.

TRANSMISSION.

SOUTH BEND, WASH.—The Willapa Power Company expects to begin work shortly on the first unit of hydroelectric power plant on South Fork.

OLYMPIA, WASH.—The commissioners of Thurston county have granted a franchise to Geo. Tilden of Seattle to run electric power lines in the county. Tilden plans the erection of a hydroelectric plant on the Snohomish River in Mason county.

COLFAX, WASH.—The Steptoe Light & Power Company has made application to the commissioners of Whitman County for a franchise to construct transmission lines for electric light and power in public highways in that county. A hearing will be held September 7th.

PHOENIX, ARIZ.—A permit has been granted to James B. Girand to develop 400,000 horsepower below the Grand Canyon of the Colorado. The permit for preliminary work issued by the department of interior states that he proposes to build at Diamond Creek a dam to develop 50,000 horsepower first, also five others to make a total output of 400,000 horsepower.

KELSO, WASH.—A new submarine electric cable has been laid across the Columbia River for the Washington-Oregon corporation under the direction of H. K. Lugger, extending from the mouth of the Kalama River directly across the Columbia to a point below Coffin Rock on the Oregon side. The cable is 2500 ft. in length and the channel where the cable crosses is about 25 ft. deep. It connects the plant of the Washington-Oregon corporation on the Oregon side of the river with the generating plant up the Kalama River, and, in case of a break-down there, with the line of the Chehalis plant of the corporation.

TRANSPORTATION.

PORTLAND, ORE.—The United Railways have been granted a 25 year franchise to operate electric freight trains over the St. Hebro road between Portland and Oilton.

SACRAMENTO, CAL.—Announcement has been made that electric traffic will be resumed over the Northern Electric to Colusa, about the middle of September.

LOS ANGELES, CAL.—A resolution adopted by the board of public utilities contemplates forcing the Pacific Electric Company to hasten work on the construction of elevated tracks to San Diego street to relieve congestion in the business district.

BREMERTON, WASH.—W. D. Peters, attorney, Bremerton, has applied to city council for a franchise for urban and interurban car lines or drives through city limits to be operated by gas or oil. He has also applied to the city of Charleston for the same privileges.

LOS ANGELES, CAL.—The members of public utilities committee of the city council recommended that the Pacific Electric Railway be granted franchise for tracks from Athens to Gardena, where it crosses the shoestring strip. The line, about 16 miles long, will connect the Pacific Railway by way of Watts with El Segundo and Redondo.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 **American Ever-Ready Works of National Carbon Co.**....
Los Angeles; 755 Folsom Street, San Francisco; Seattle.

B-2 **Benjamin Electric Manufacturing Co.**.....
590 Howard Street, San Francisco

B-5 **Bridgeport Brass Co.**..... 4
(See Pierson, Roeding & Co.)

B 7 **Busch-Sulzer Bros.-Diesel Engine Co.**..... 3
Rialto Bldg., San Francisco.

C-1 **Century Electric Co.**..... 3
614 South Grand Avenue, Los Angeles; 56 Natoma Street, San Francisco; Seattle; Spokane.

C-3 **Crocker-Wheeler Co.**.....
Salt Lake City; Crossley Bldg., 618 Mission St., San Francisco; Seattle.

C-4 **Cutler-Hammer Manufacturing Co.**.....11
579 Howard Street, San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-1 **D. & W. Fuse Co.**.....
Western Electric Co.

D-2 **Dearborn Drug and Chemical Works**..... 3
355 East Second Street, Los Angeles; 301 Front Street, San Francisco.

D-3 **Dover Manufacturing Co.**.....
Canal Dover, Ohio.

E-1 **Edison Lamp Works of General Electric Co.**.....
Rialto Bldg., San Francisco.

E-2 **Edison Storage Battery Supply Co.**..... 5
441 Golden Gate Avenue, San Francisco.

E-3 **Electric Agencies Co.**.....
247 Minna Street, San Francisco; Central Building, Los Angeles.

E-4 **Electric Storage Battery Co.**.....
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; 118 New Montgomery Street, San Francisco; Colman Bldg., Seattle.

E-5 **Electric, Railway & Manufacturers Supply Co.**..... 2
84 Second Street, San Francisco.

F-1 **Fairbanks, Morse & Co.**.....12
Los Angeles; Portland; 651 Mission Street, San Francisco; Seattle; Spokane.

F-3 **Federal Sign System (Electric)**.....
618 Mission Street, San Francisco.

G-1 **General Electric Co.**..... 10
124 W. Fourth Street, Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-2 **General Vehicle Co.**.....
1117 Van Ness Avenue, San Francisco; 331 Wall Street, Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 **Habirshaw Wire Co.**.....
(See Western Electric Company.)

H-2 **Hemingray Glass Co.**..... 2
330 So. L. A. Street, Los Angeles; 345 Oak Street, Portland; 807 Mission Street, San Francisco.

H-5 **Hunt, Mirk & Co.**.....
141 Second Street, San Francisco.

H-6 **Hubbard & Co.**.....
Rialto Bldg., San Francisco.

I-1 **Indiana Rubber and Insulated Wire Co.**..... 4
Fobes Supply Co., Portland and Seattle.

K-1 **Kellogg Switchboard and Supply Co.**.....
Aronson Bldg., San Francisco.

K-2 **M. W. Kellogg Co.**.....
(See Pierson, Roeding & Co.)

L-1 **Leahy Manufacturing Co.**..... 3
Eighth and Alameda Street, Los Angeles.

L-2 **Locke Insulator Manufacturing Co.**..... 4
(See Pierson, Roeding & Co.)

M-2 **McGlauflin Manufacturing Co.**..... 5
Sunnyvale, Cal.

M-4 **Morse Chain Co.**.....
Monadnock Bldg., San Francisco.

M-3 **Moore & Co., Charles C.**..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 **Nason & Co., R. N.**.....
151 Potrero Avenue, San Francisco.

N-2 **National Conduit & Cable Co., The**.....
Trust and Savings Bldg., Los Angeels; Rialto Bldg., San Francisco.

N-3 **National Lamp Works of G. E. Co.**.....
(All Jobbers.)

N-4 **New York Insulated Wire Co.**.....
629 Howard Street, San Francisco.

N-5 **Northwestern Pacific Railroad**..... 3

O-1 **Okonite Co. (The)** 12
(All Jobbers.)

P-1 **Pacific Electric Manufacturing Co.**.....
80 Tehama Street, San Francisco.

P-2 **Pacific States Electric Co.**..... 2
236-240 So. L. A. Street, Los Angeles; 90 Seventh Street, Portland; 200-210 12th Street, Oakland; 575 Mission Street, San Francisco; 307 First Avenue, So., Seattle.

P-4 **Pelton Water Wheel Co.**..... 2
2219 Harrison Street, San Francisco.

P-5 **Pierson, Roeding & Co.**..... 4
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 **Pittsburgh Piping & Equipment Co.**.....12
Monadnock Bldg., San Francisco.

S-1 **Schaw-Batcher Company, Pipe Works, The**.....
211 J Street, Sacramento; 356 Market Street, San Francisco.

S-3 **Simplex Electric Heating Co.**.....12
612 Howard Street, San Francisco.

S-4 **Southern Pacific Co.**..... 2
Flood Bldg., San Francisco.

S-5 **Sprague Electric Works**..... 3
Rialto Bldg, San Francisco; Colman Bldg.; Seattle; 124 West 4th Street, Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 **Standard Underground Cable Co.**.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 **Thomas & Co., R.**.....
(See Western Electric Co.)

W-2 **Western Electric Co.**.....
8th and Santee Streets, Los Angeles; 507 Sixteenth Street, Oakland; 680 Folsom Street, San Francisco; 907 First Avenue, Seattle; 45 North Fifth Street, Portland, Ore.

W-4 **Westinghouse Electric and Manufacturing Co.**..... 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second Street, San Francisco; Second and Cherry Streets, Seattle; Paulsen Bldg., Spokane.

W-5 **Westinghouse Machine Co.**.....
141 Second Street, San Francisco.

W-6 **Westinghouse Lamp Co.**.....
(See Westinghouse Electric and Manufacturing Co.)

W-8 **Western Pipe & Steel Co.**.....
444 Market Street, San Francisco; 1758 North Broadway, Los Angeles.